

## CLAIMS

We claim:

1. A portable human gait analysis apparatus for releasable securement about a user's foot, wherein the apparatus comprises:
  - a) a detachable sole;
  - b) a soft casing unit having a detachable sole cover, a detachable foot cover, a detachable shank cover, and a releasable securement means for releasably and adjustably securing the detachable sole cover, the detachable foot cover, and the detachable shank cover about said user's foot;
  - c) a plantar pressure collection unit positioned between a plantar side of said user's foot and the detachable sole;
  - d) a rearfoot motion collection unit having at least one accelerometer sensor and at least one rate sensor;
  - e) a lower shank motion collection unit having at least one accelerometer sensor and at least one rate sensor;
  - f) a detachable processing unit in electrical communication with the plantar pressure collection unit, the rearfoot motion collection unit, and the lower shank motion collection unit, said detachable processing unit for processing data from a plurality of said accelerometers and said sensors; and

g) a visual display unit in electrical communication with the detachable processing unit for displaying the data processed by the processing unit.

2. The portable human gait analysis apparatus of claim 1, wherein said soft casing unit is sized to fit within a user's shoe, with the rearfoot motion collection unit, the lower shank motion unit, and the processing and display unit attached to the outer portion of the user's shoe.

3. The portable human gait analysis apparatus of claim 1, wherein independent measurements are taken for said user's right foot and left foot, and said processing and display units function independently for each foot.

4. The portable human gait analysis apparatus of claim 1, wherein past and current data is stored in memory, and processed by the central processing unit for comparison between use.

5. The portable human gait analysis apparatus of claim 1, wherein the display unit is a LCD display unit.

6. The portable human gait analysis apparatus of claim 1, wherein the data from the central processing unit passes through an I/O unit to a telemetry unit for transfer to at least one of a PC and PDA, for storage and further analysis.

7. The portable human gait analysis apparatus of claim 6, wherein the data from the telemetry unit is transferred to at least one of: a walkman, a TV, a VCR, a DVD player, a CD player, a projection unit, a game console, a stereo and an internet site for entertainment purposes.

8. The portable human gait analysis apparatus of claim 1, wherein the central processing unit processes data from the plurality of accelerators and sensors to determine pronation, supination and normal data based upon data received from the FMC and the SMC.

9. The portable human gait analysis apparatus of claim 1, wherein a user's body weight is calibrated by the central processing unit to provide a baseline for processing data.

10. The portable human gait analysis apparatus of claim 1, wherein the detachable sole is flexible, durable, electrically insulating, and resilient.

11. A portable human gait analysis apparatus for releasable securement about a user's foot, wherein the apparatus comprises:

a) a detachable sole which is flexible, durable, electrically insulating, and resilient;

b) a soft casing unit having a detachable sole cover, a detachable foot cover, a detachable shank cover, and a releasable securement means for releasably and adjustably securing the detachable sole cover, the detachable foot cover, and the detachable shank cover about said user's foot;

c) a plantar pressure collection unit positioned between a plantar side of said user's foot and the detachable sole, to identify the center of pressure line and excessive and abnormal loads on the sole of the foot;

d) a rearfoot motion collection unit having at least one accelerometer sensor and a plurality of rate sensors to calculate rearfoot kinematic data crucial to identify the motions of pronation and supination;

e) a lower shank motion collection unit having at least one accelerometer sensor and a plurality of rate sensors to provide lower shank motion data, which when combined with data from the rearfoot kinematic data, to provide three dimensional static and dynamic acceleration, angular velocity, two-axis tilt information, and static and dynamic foot movements;

f) a detachable processing unit in electrical communication with the plantar pressure collection unit, the rearfoot motion collection unit, and the lower shank motion collection unit, said detachable processing unit for processing data from said accelerometers and said plurality of sensors; and

g) a visual display unit in electrical communication with the detachable processing unit for displaying the data processed by the processing unit.

12. The portable human gait analysis apparatus of claim 11, wherein the plantar pressure collection unit positions force sensor resistors and pressure sensors along a first phalange, a second phalange, a third phalange, a fourth phalange in the forefoot, along a first metatarsal head, a second metatarsal head, and a fourth metatarsal head in the forefoot, along a first metatarsal base, a fourth metatarsal base and a fifth metatarsal base in the midfoot, underneath a distal portion of a medial and lateral side of a calcaneus in the midfoot, and at the medial and lateral surfaces of the calcaneus in the rearfoot, to provide accurate measurement of maximum pressure, mean pressure, and pressure line.

17 12. The portable human gait analysis apparatus of claim 11, wherein the information displayed on the processing and display unit comprises vital gait information, including over-pronate, supinate, and neutral plantar pressure distribution and the amount of eversion/inversion angle.

18 13. The portable human gait analysis apparatus of claim 11, wherein the processing and display unit provides a color coded mapping data, which has been normalized by body weight calibration.

15 14. The portable human gait analysis apparatus of claim 1, wherein said soft casing unit is sized to fit within a user's shoe, with the rearfoot motion collection unit, the lower shank motion unit, and the processing and display unit attached to the outer portion of the user's shoe.

16 15. The portable human gait analysis apparatus of claim 1, wherein independent measurements are taken for said user's right foot and left foot, and said processing and display units function independently for each foot.

17 16. The portable human gait analysis apparatus of claim 1, wherein past and current data is stored in memory, and processed by the central processing unit for comparison between use.

18 17. The portable human gait analysis apparatus of claim 1, wherein the display unit is a LCD display unit.

19 18. The portable human gait analysis apparatus of claim 1, wherein the data from the central processing unit passes through an I/O unit to a telemetry unit for transfer to at least one of a PC and PDA, for storage and further analysis.

20 19. The portable human gait analysis apparatus of claim 6, wherein the data from the telemetry unit is transferred to at least one of: a walkman, a TV, a

VCR, a DVD player, a CD player, a projection unit, a game console, a stereo and an internet site for entertainment purposes.

20. A portable human gait analysis apparatus for releasable securement

about a user's foot, wherein the apparatus comprises:

- a) a detachable sole which is flexible, durable, electrically insulating, and resilient;
- b) a soft casing unit having a detachable sole cover, a detachable foot cover, a detachable shank cover, and a releasable securement means for releasably and adjustably securing the detachable sole cover, the detachable foot cover, and the detachable shank cover about said user's foot;
- c) a plantar pressure collection unit positioned between a plantar side of said user's foot and the detachable sole, to identify the center of pressure line and excessive and abnormal loads on the sole of the foot;
- d) a rearfoot motion collection unit having at least one accelerometer sensor and a plurality of rate sensors to calculate rearfoot kinematic data crucial to identify the motions of pronation and supination;
- e) a lower shank motion collection unit having at least one accelerometer sensor and a plurality of rate sensors to provide lower shank motion data, which when combined with data from the rearfoot kinematic data, provides three dimensional static and dynamic acceleration, angular

velocity, two-axis tilt information, and static and dynamic foot movements;

- f) a detachable processing unit in electrical communication with the plantar pressure collection unit, the rearfoot motion collection unit, and the lower shank motion collection unit, said detachable processing unit for processing data from said accelerometers and said plurality of sensors, which has been normalized by body weight calibration; and
- g) an LCD visual display unit in electrical communication with the detachable processing unit for displaying the data processed by the processing unit, and the information displayed comprises vital gait information, including over-pronate, supinate, and neutral plantar pressure /distribution and the amount of eversion/inversion angle of the user's foot.

21. The portable human gait analysis apparatus of claim 20, wherein the plantar pressure collection unit positions force sensor resistors and pressure sensors along a first phalange, a second phalange, a third phalange, a fourth phalange in the forefoot, along a first metatarsal head, a second metatarsal head, and a fourth metatarsal head in the forefoot, along a first metatarsal base, a fourth metatarsal base and a fifth metatarsal base in the midfoot, underneath a distal portion of a medial and a lateral side of a calcaneus in the midfoot, and at

the medial and lateral surfaces of the calcaneus in the rearfoot, to provide accurate measurement of maximum pressure, mean pressure, and pressure line.

*23* 22. The portable human gait analysis apparatus of claim *20*, wherein independent measurements are taken for said user's right foot and left foot, and said processing and display units function independently for each foot.